Software-Intensive Systems Producibility Initiative

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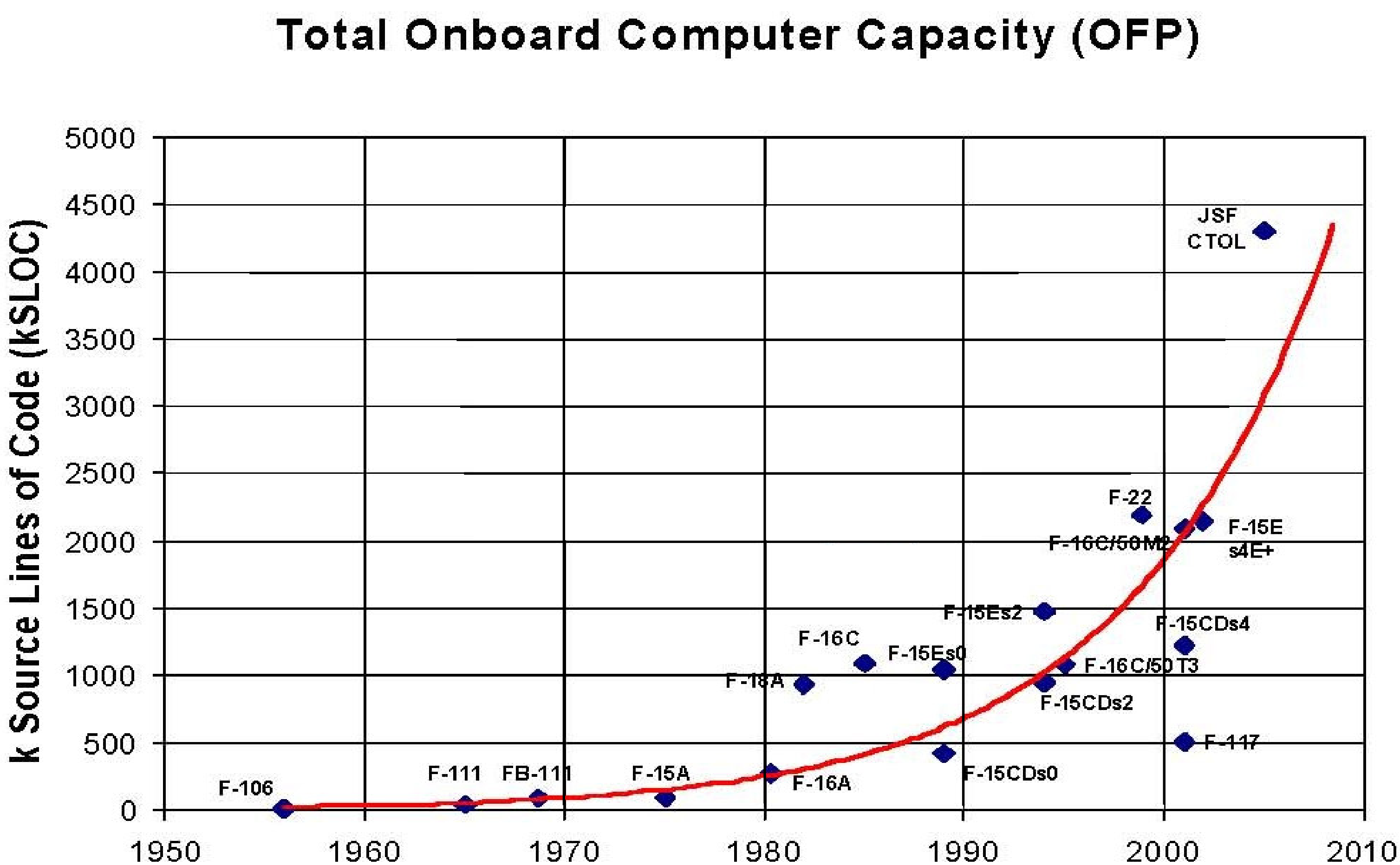
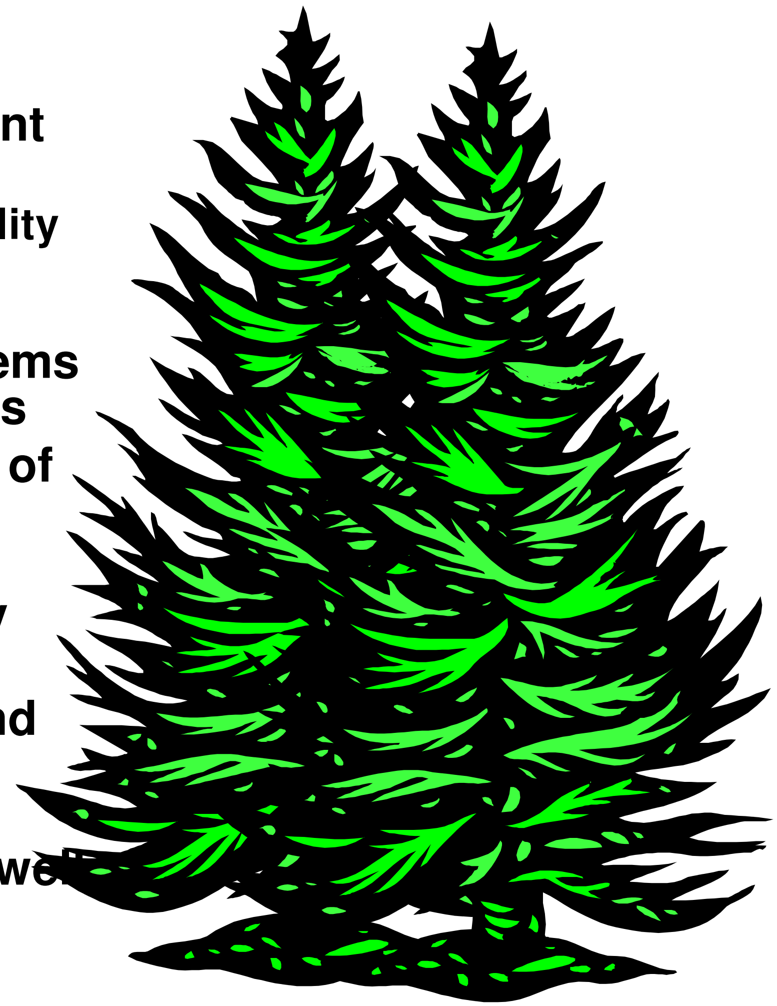
DoD Software is Growing in Size and Complexity



Source: "Avionics Acquisition, Production, and Sustainment: Lessons Learned -- The Hard Way", NDIA Systems Engineering Conference, Mr. D. Gary Van Oss, October 2002.

Software PRodUcibility Collaboration and Evaluation Environment (SPRUCE^2)

- **Managed by the Air Force**
- **Open collaborative research and development environment**
  - **Demonstrate, evaluate, and document the ability of novel tools, methods, techniques, and technologies**
- **Facilitate testing of Software-Intensive Systems Producibility research products and methods**
- **Provide a realistic environment for research of DoD embedded systems and software problems**
- **Provide an ability for university and industry leverage of technology development,**
- **Support successful technology transition and transfer**
- **Investigators will collaborate with major defense acquisition program developers as well as analyzing the utility of tools**



Note: SPRUCE^2 is the new name for the Systems and Software Test Track (SSTT).

SPRUCE^2 Phase I Completed

- **Defined Concept of Operations (CONOPS)**
  - **Facility characteristics for a proposed system from the users' viewpoint.**
- **Defined Architecture and the fundamental organization of the SPRUCE^2**
  - **Components,**
  - **Their relationships to each other and the environment, and**
  - **Principles governing its design and evolution.**

SPRUCE^2 Phase II Goals

- **Implement the architecture of SPRUCE^2**
- **Stand up the fundamental organization of SPRUCE^2**
- **Begin experimentation**
- **Identify challenge problems that require research**
  - **Develop representative case studies**

AF 2005 SBIR: Software Hub

SBIR Objective

Facilitate use of state-of-the-art analysis tools with commercial model-driven development tools

–***Kestrel Technology LLC***

- Develop architecture and hub language that support semantic integration of models
- Establish both as formal standards

–***Reactive Systems, Inc.***

- Collaborate with Kestrel Technology
- Develop translators between hub language and
  - Simulink® /Stateflow® modeling languages
  - SALSA analysis tool
  - Reactis® automated test generator

AF 2006 STTR: Error Handling Paths & Policies Analysis

STTR Objective

Approaches and tools to analyze existence, completeness, and adequacy of error handling policies and paths

- ***GrammaTech, Inc.***
  - Analyze error behavior at component boundaries using machine code & file/socket format analysis
  - Trace error propagation, flag policy violations, or uncontained errors
- ***WW Technology Group***
  - Model-driven development of error-handling architecture based on SBIR-developed EDICT tool suite
  - Tradeoff analysis of alternative architectures using multiple formalisms and stochastic & statistical approaches

Naval Research Lab Software-Intensive System Producibility S&T

Sage. Methods and tools supporting **agile, model-driven development** of high assurance distributed agent-based systems

SOL. Declarative specification language supporting **automated synthesis** of distributed agent-based systems

SALSA. Static analysis tool establishes **behavioral properties** of ***SOL***-*like* specifications

SINS. Secure deployment, management, and communication **infrastructure for distributed agents**

Secure open source software. Methods and tools facilitating adaptation, development, and/or **assurance of open source software** for DoD use.

Army Software Technologies for Interoperable Systems of Systems

- Develop and establish principles of interoperability and complexity management
  - Foundation for developing a service-oriented architecture for ultra large scale systems
- Two awards
  - UC Berkeley
  - Vanderbilt University

Army BAA – UC Berkeley

- Composition of systems based on
  - Integration technologies for legacy and custom subsystems that provide an understanding of the interaction of subsystems;
  - Scalable composition mechanisms for system-of-systems architectures;
  - Interface formalisms through which compatibility and properties of compositions can be determined from properties of the subsystems;
  - Ontology models for the organization of components together with a semantic type system for the data on which they operate; and
  - Hybrid models for designing and analyzing the dynamics of subsystem interactions with their physical environment

Army BAA – Vanderbilt U

- Enable system architects and integrators in creating large-scale SOA-based systems on MANETs
  - "Model-based tools for Service Architectures on Mobile Ad hoc Networks." (MOSAMAN)
- Emphasis on model-based approaches
  - Service Oriented Architecture middleware and
  - Applications on Mobile Ad hoc Network platforms
- Results and deliverables include
  - Domain-specific modeling environments
  - Analysis tool chains, and
  - Architecture analysis tradeoffs

Future Activities

- Navy-led new start in FY2008
- Completion of the National Academy of Sciences study
  - "Advancing Software Intensive Systems Producibility"
- SISPI and ULS Technology Focus Team
  - Technology Roadmap
  - Industry Summit
  - Recommendation for POM-10 investment
- Coordinate with National Science Foundation Cyber-Physical Systems initiative

Software-Intensive System (SIS) Producibility

Program Overview

- Enable DoD to develop and affordably acquire software for large-scale, complex, embedded and net-centric systems by providing innovations in technologies, tools and techniques
- Invigorate DoD software research and provide dedicated efforts to demonstrate and transition improvements to acquisition programs
- Issues:
  - Software is an integral part of advanced warfighting systems but owing to technology shortfalls, DoD software-intensive acquisitions experience serious inefficiency, cost/schedule overruns, and critical failures
  - Trends in software size and complexity grow exponentially

Project Structure

- Projects to be funded with POM-08 Request
  - Software and Systems Development Focused Research Centers
  - Software and Systems Test Track
  - Transition

Program Objectives

- Develop new technologies, tools and techniques that achieve 20% productivity improvement and 20% reduction in re-work by FY14
- Demonstrate impacts of technology improvements on representative acquisition program software artifacts
- Transition new technologies to software-intensive acquisition programs
- Milestones
  - Release BAA(s) Summer '06
  - Establish university/industry centers, research mid-'07
  - Software test track, 2007

Metrics/Benefit

- Long-Term measures –
  - Improved affordability (improving trends in software cost and schedule from DoD 5000 SRDR*)
  - Reduced software re-work
  - Improved programmatic predictability
  - Increased industry productivity (SLOC/MM)
  - Decreased defect density (defects/1000SLOC)
- Will enable DoD to acquire software with reduced cost/schedule, increased quality, and avoid cost/schedule overruns by reducing rework

* Software Resources Data Report

SISP Technology Ecosystem

Education
Training
Tools
Publications

Acq | Oversight, Prog Mgmt, Test | Warfighters

Integrators

Developers

Tool Vendors | Stds Bodies | Start-ups | Champions/ Agents | Open Source | Industry Gurus

Research
Academia | Industry | Gov't Labs

NSF, NIST, DoD S&T

Opportunities for Progress

Rules of Engagement	People	Product	Process & Proj mgmt	Tools Technologies Techniques
Law Policy Business Models	Education Training Licensing Experience #'s	Existing code Libraries OS/Middleware DOTS GOTS COTS Product Lines	CMMI iCMM ISO 9000 Lean 6Sigma TOC	MDA Code Checkers Code generators Req'ts mgrs Visualization Etc.